REMARKS

Review and reconsideration on the merits are requested.

Claim Amendments

Composition claims 1 to 6 have been cancelled. Claims 7 and 8 have each been amended by incorporating the subject matter of original claim 1. New claims 9 to 13 depending from claim 7 correspond to original claims 2 to 6, and new claims 14 to 18 depending from claim 8 correspond to original claims 2 to 6.

The Present Invention

The present invention as claimed in claim 7 is directed to a diesel engine system running on diesel fuel with not more than 10 mass ppm sulfur. The diesel engine system comprises a regenerative DPF, wherein the accumulation of depositing components on the regenerative DPF is inhibited.

The present invention as claimed in claim 8 is directed to a method for inhibiting accumulation of a depositing component on a regenerative DPF in a diesel engine system.

As described in "BACKGROUND ART" of the present specification, in light of environmental problems, it is known to provide a diesel engine system with a DPF (diesel particulate filter) or like means for reducing exhaust gas emissions from the diesel engine. However, a DPF has problems in that the particulate matter (PM) captured from the exhaust gas accumulates, which results in clogging of the DPF to increase pressure loss, which lowers engine power and/or deteriorates fuel efficiency. To overcome such problems, the DPF is replaced after a certain mileage, or is continuously regenerated.

Another factor involved in the present invention was that the sulfur content of motor vehicle diesel fuels has gradually been reduced. At the time of the priority date of the present

application, diesel oils with about 0.005 mass% (50 mass ppm) sulfur had become popular (see "BACKGROUND ART" of the specification). This meant that diesel fuel with as little as 10 mass ppm or less of sulfur, as defined in claims 7 and 8, was not in great use at the time of the priority date of the present application. Similar teaching is also presented in Nakazato et al. cited by the Examiner, which disclose at column 1, lines 42 to 46 that diesel fuel at the time of the disclosure had a sulfur content of approximately 0.05 wt% (500 mass ppm), and it was expected that decreasing the sulfur content to 0.01 wt% (100 mass ppm) or lower and even further to approximately 0.001 wt% (10 mass ppm) or lower, might be required.

It was known at the time of the priority date of the present application that a high ash content, in particular a high sulfated ash content, of a lubricant composition used in a diesel engine system caused clogging of a DPF in the system.

However, the present Inventors found that merely reducing the sulfated ash content of a lubricant composition would not sufficiently lower the differential pressure of a regenerated DPF. Further, the clogging behavior of a DPF in a diesel engine system is different when the system is run on diesel fuel with about 50 mass ppm sulfur (which was typical at the time of the priority date of the present application) as compared to when the system was run on diesel fuel with not more than 10 mass ppm sulfur (as claimed in claims 7 and 8). This different clogging behavior was encountered even when similar lubricant compositions were used in the system.

Taking into consideration the trend of regulations to further reduce the sulfur content of diesel fuel, the present Inventors searched for a lubricant composition suitable for inhibiting the accumulation of a depositing component on a regenerative DPF, and discovered such a lubricant composition for use in a diesel engine system running on diesel fuel with not more than 10 mass

ppm sulfur and comprising a regenerative DPF and also a method for inhibiting accumulation of a depositing component on a regenerative DPF in a diesel engine system.

Discussion of Examples and Comparative Examples in the Specification

The present invention is now explained in more detail with reference to the Examples and Comparative Examples in the present specification, in particular Table 1.

Referring to Table 1, in Examples 1-7 and Comparative Examples 1-3, diesel fuel with 4 mass ppm (0.0004 mass%) sulfur was used, which is within the range claimed herein.

In distinction, in Comparative Example 4, where the lubricant composition was the same as in Example 6, diesel fuel with 45 mass ppm (0.0045 mass%) sulfur was used, which is outside the range claimed. Diesel fuel with 45 mass ppm sulfur is typical of the type of diesel fuel used at the time of the priority date of the present application.

Comparing Example 6 and Comparative Example 4, which employ the same lubricant composition, it can be seen that the DPF differential pressure after testing in Comparative Example 4 (fuel with 45 mass ppm sulfur) was 3.4 kPa, which is much higher than the 0.8 kPa in Example 6 (fuel with 4 mass ppm sulfur). Thus, the regenerated DPF was more severely clogged in Comparative Example 4 than in Example 6.

It has thus been demonstrated that to inhibit accumulation of a depositing component on a regenerative DPF in a diesel engine system, the lubricant composition used should be decided based on the sulfur content of the diesel fuel used.

Comparing Comparative Example 4 using the diesel fuel with 45 mass ppm sulfur with Comparative Examples 1-3 using the diesel fuel with 4 mass ppm sulfur as in the Examples, it can be seen that the DPF differential pressures after testing in Comparative Examples 1-3 were

8.2 kPa, 6.2 kPa, 4.3 kPa, respectively, which are disadvantageously higher than the 3.4 kPa in Comparative Example 4.

It has thus been demonstrated that clogging of a DPF cannot be inhibited merely by employing diesel fuel with a lower sulfur content.

From Comparative Example 3, which uses the same diesel fuel (4 mass ppm sulfur) as in the Examples and a lubricant composition having a very low sulfated ash content (0.6 mass%) as compared to the lowest sulfated ash content (0.5 mass%) among the Examples, it can be seen that the DPF differential pressure after testing in Comparative 3 was 4.3 kPa, which is much higher than any of the Examples.

It has thus been demonstrated that a mere reduction of the ash content of the lubricant composition does not inhibit clogging of the DPF in a diesel engine system running on diesel fuel with not more than 10 mass ppm sulfur, a finding which would be contrary to what one of ordinary skill in the art would expect.

It must be kept in mind that a lubricant composition for a diesel engine system running on diesel fuel with a higher sulfur content (50 to 100 mass ppm) would have been typical at the time of the priority date of the present application. Against this background, from the above results, one of ordinary skill in the art would have understood that such a high sulfur content diesel fuel cannot simply be used as a lubricant composition for a diesel engine system running on diesel fuel with not more than 10 mass ppm sulfur and expect to achieve an inhibiting of the accumulation of a depositing component on a regenerative DPF in the system.

One of ordinary skill in the art would also have understood that a mere reduction of the ash content of a lubricant composition would not have resulted in inhibiting the accumulation of

a depositing component, and a lubricant composition needs to be decided depending on the sulfur content of the diesel fuel.

Considering all of the above factors, a major feature of the present invention resides in the use of a lubricant composition which is capable of inhibiting accumulation of a depositing component on a regenerative DPF in a diesel engine system running on diesel fuel with not more than 10 mass ppm sulfur.

In more detail, the lubricant composition used in claims 7 and 8 permits one to achieve the objects of the present invention. This is the case in particular when all of (1) the sulfated ash content, (2) the M/P ratio, (3) the B/M ratio, and (4) the S/M ratio fall within the ranges claimed.

One of ordinary skill in the art would have understood from the Comparative Examples above discussed that it is necessary that all of factors (1), (2), (3), and (4) must be met to achieve the objects of the present invention. Specifically, from Comparative Examples 1 and 2 it is clear that the objects of the present invention cannot be achieved when (3) the B/M ratio is outside the claimed range, and from Comparative Example 3 that the objects of the present invention cannot be achieved when (4) the S/M ratio is outside the claimed range.

Against the above background, Applicants now discuss the prior art relied upon and traverse the rejection.

The First Art Rejection

Claims 1-8 were rejected under 35 U.S.C. 103(a) as being unpatentable over Goto et al. (USP 5,965,495) in combination with Katafuchi (USP 6,962,614) and Nakazato et al. (USP 6,569,818). The above prior art will be referred to as Goto, Katafuchi and Nakazato, respectively.

Applicants traverse the above rejection below.

The Examiner's position is set forth in the Action and will not be repeated here except as necessary to an understanding of Applicants' traversal which is now presented.

Traversal

Goto disclose a lubricating oil composition for diesel engines comprising a means for removing particulate materials in exhaust gas. The lubricating oil composition comprises a base oil and, as additives: (a) an ashless dispersant containing boron, (b) a metallic detergent including sulfonates, phenates, and salicylates of alkali and alkaline earth metals, and, optionally, (c) esters of aromatic carboxylic acids having a hydroxyl group, and ZnDTP, which is a phosphorus-based anti-wear agent. It is also disclosed that the B/M ratio of the lubricating oil composition is 0.15 to 1.5, and the sulfated ash content is not more than 1.5 wt%.

Katafuchi teaches that diesel engines equipped with a regenerative DPF are known in the art.

Nakazato teaches that diesel fuel at the time of the Nakazato disclosure had a sulfur content of approximately 0.05 wt% (500 mass ppm), and it was expected that requirements for decreasing the sulfur content to 0.01 wt% (100 mass ppm) or lower and even further to approximately 0.001 wt% (10 mass ppm) or lower, may be posed.

As established from the earlier presented discussion, the unexpectedly superior effects of the present invention cannot be achieved unless (1) the sulfated ash content, (2) the M/P atomic ratio, (3) the B/M atomic ratio, and (4) the S/M atomic ratio fall within the particular ranges claimed.

Goto does not disclose in the Goto Examples any evaluation of the number of regenerations of a regenerative DPF or even any inhibition of any increase in the DPF

differential pressure after regeneration, which evaluations would, it is submitted, be considered mandatory to evaluate the system of the present invention by one of ordinary skill in the art.

Further, Goto does not even suggest using the Goto lubricating oil composition in a diesel engine system running on diesel fuel with not more than 10 mass ppm sulfur and having a regenerative DPF as in the present invention.

Still further, Goto, even in combination with Nakazato, does not suggest that the same lubricant composition does not have a similar inhibiting effect on clogging of a regenerative DPF depending on the sulfur content of the diesel fuel. This is demonstrated by a comparison of Example 6 and Comparative Example 4 in the present specification.

Further, Goto does not suggest that a reduction of the ash content of a lubricant composition cannot result in inhibiting clogging of a regenerative DPF when diesel fuel with not more than 10 mass ppm sulfur is used.

Finally, Goto does not suggest that a lubricant composition for use in a diesel engine system needs to be decided depending on the sulfur content of the diesel fuel.

In summary, the cited references do not teach the problem solved by the present invention, i.e., even a lubricant composition providing good performance in an engine system running on diesel fuel with 50 to 100 mass ppm sulfur, typical at the time of the priority date of the present application, cannot be used as it is in an engine system running on diesel fuel with not more than 10 mass ppm sulfur, still less the means for solving such problem.

Therefore, the present invention is not obvious over Goto et al. in combination with Katafuchi and Nakazato et al.

Second Obviousness Rejection

The Rejection

Claims 1-8 were also rejected under 35 U.S.C. 103(a) as being unpatentable over Ogano et al. (USP 6,638,897) in combination with Katafuchi (USP 6,962,614) and Nakazato et al. (USP 6,569,818). Ogano et al will be referred to hereafter as Ogano.

Traversal

Ogano disclose low-phosphorus and low-ash lubricating oil compositions for diesel engines which are equipped with a filtration system such as a DPF.

The lubricating oil compositions comprise a mineral oil and/or a synthetic oil and, as additives: (a) an overbased calcium salicylate, (b) an ashless dispersant such as a boron-containing succinimide, and, optionally, ZnDTP, which is a phosphorus-based anti-wear agent.

With respect to amounts, Ogano also discloses that component (a) is incorporated at 0.10 to 0.90 wt%, preferably 0.5 to 0.9 wt% as calcium, and that component (b) is incorporated at 0.04 wt% or less as boron.

Katafuchi teaches that diesel engines equipped with a regenerative DPF are known in the art.

Nakazato teaches that diesel fuel at the time of the Nakazato disclosure had a sulfur content of approximately 0.05 wt% (500 mass ppm), and it was expected that requirements for decreasing the sulfur content 0.01 wt% (100 mass ppm) or lower and even further to approximately 0.001 wt% (10 mass ppm) or lower, may be posed.

As earlier discussed, the superior effects of the present invention cannot be achieved unless all of (1) the sulfated ash content), (2) the M/P atomic ratio, (3) the B/M atomic ratio, and (4) the S/M atomic ratio fall within the ranges claimed.

However, Ogano does not teach in any fashion the necessity that all of the features (1) to (4) defined in claims 7 and 8 of the present application must be met to meet the objects of the present invention.

Further, Ogano does not disclose in the Ogano Examples any evaluations of the number of regenerations of a regenerative DPF or the inhibition of an increase in DPF differential pressure after regeneration, which are among the major advantages of the present invention.

Ogano further does not suggest using the Ogano lubricating oil composition in a diesel engine system running on diesel fuel with not more than 10 mass ppm sulfur and having a regenerative DPF as in the present invention.

Further, Ogano, even in combination with Nakazato, does not suggest that the same lubricant composition does not have a similar inhibiting effect on clogging of a regenerative DPF depending on the sulfur content of the diesel fuel. This is demonstrated by a comparison of Example 6 and Comparative Example 4 in the present specification.

Also, Ogano does not suggest that a reduction of the ash content of a lubricant composition cannot result in inhibiting clogging of a regenerative DPF when diesel fuel with not more than 10 mass ppm sulfur is used.

Finally, Ogano does not suggest that a lubricant composition for use in a diesel engine system needs to be decided depending on the sulfur content of the diesel fuel.

In summary, the cited references do not teach the problem to be solved by the present invention, i.e., even a lubricant composition providing good performance in an engine system running on diesel fuel with 50 to 100 mass ppm sulfur, typical at the time of the priority date of the present application, cannot be used as it is in an engine system running on diesel fuel with not more than 10 mass ppm sulfur, still less the means for solving such problem.

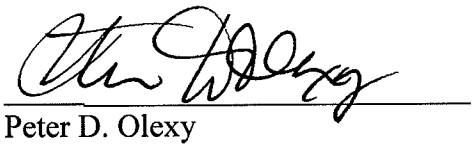
Therefore, the present invention is not obvious over Ogano in combination with Katafuchi and Nakazato.

Withdrawal of all rejections and allowance is requested.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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